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Title: Impact of home-based palliative care on health care costs and hospital use: a systematic review.

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Abstract

Objectives: To assess the effectiveness of home-based palliative care on reducing hospital visits and whether HBPC lowered health care cost.

Methods: We searched six bibliographic databases (Embase (Ovid); Cochrane Central Register of Controlled Trials; Medline (Ovid); PubMed; Web of Science Core Collection; and, CINAHL) until February 2019 and performed a narrative synthesis of our findings.

Results: Of the 1,426 identified references, 21 articles based on 19 unique studies met our inclusion criteria, which involved 92,000 participants. In both oncological and non-oncological patients, home-based palliative care consistently reduced the number of hospital visits and their length, as well as hospitalization costs and overall health care costs. Even though home-treated patients consumed more outpatient resources, a higher saving in the hospital costs counterbalanced this. The reduction in overall health care costs was most noticeable for study periods closer to death, with greater reductions in the last two months, last month and last two weeks of life.

Significance of results: Stakeholders should recognize home-based palliative care as an intervention that decreases patient care costs at end of life and therefore health care providers should assess the preferences of patients nearing the end-of-life to identify those who will benefit most from home-based palliative care.

Key words

Health Care Cost; domiciliary care; community care; palliative care

Introduction

As the population of the world ages (He, Goodkind, & Kowal, 2016), demand for health and social care is increasing, raising costs and placing ever greater burdens on national health care systems (Guzman-Castillo et al., 2017).

In this context, a careful evaluation of healthcare resources is crucial to deliver the most appropriate treatments to patients with severe chronic illnesses. Besides treatments focused on curing, patients with prevalent non-curative chronic conditions have a great need of care-oriented treatments, including palliative care (PC). Such a treatment is an approach that seeks to improve the quality of life of patients and their families by the prevention and alleviation of suffering through early identification, evaluation, and treatment of pain and other physical, psychosocial, and spiritual problems ("World Health Organization. WHO definition of palliative care,"). Inpatient palliative care effectively improves patients' quality of life and satisfaction with their care (Gade et al., 2008) and a recent meta-analysis showed that palliative care lowers hospital costs for patients (May et al., 2018). However, inpatient palliative care is not for everyone; patients with terminal illness benefit even more when palliative care and other types of care are delivered to them at home. Home care reduces hospital visits and hospital deaths, which is associated with better quality of life for patients at the end of life (Zhang, Nilsson, & Prigerson, 2012).

Effectiveness and cost-effectiveness of home-based general care has already been shown (Maru et al., 2015; Winkler et al., 2018). A 2013 Cochrane systematic review determined the effectiveness of home-based palliative care (HBPC) in reducing symptom burden for patients, and also pointed out that there was not enough literature to assess cost effectiveness. It also found that most of the literature focused on oncological patients (Gomes, Calanzani, Curiale, McCrone, & Higginson, 2013). Several more recent studies have assessed the economic impact of HBPC. To date, a comprehensive and systematic appraisal of the existing literature on this impact is missing. Therefore, we conducted a systematic

review to 1) assess the effectiveness of HBPC on reducing hospital visits, and 2) assess whether HBPC lowered health care costs.

Methods

Literature search

We conducted a systematic review that follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline and registered the protocol in PROSPERO (Moher, Liberati, Tetzlaff, Altman, & Grp, 2009).

With the aid of an experienced medical information specialist (DK) we searched six electronic databases for peer-reviewed scientific literature related to cost of HBPC, with the goal of identifying studies published between 2013 and 11 February 2019 (date of last search). The search was done in Embase (Ovid); Cochrane Central Register of Controlled Trials; Medline (Ovid); PubMed; Web of Science Core Collection; and, CINAHL. We combined terms related to the exposure (palliative care, end-of-life care, ambulatory care, domiciliary care) and our outcomes (health expenditures, health care costs, hospitalization rate). We did not apply a language restriction. The full search strategies are available in the appendix (**Supplementary material 1**). To identify additional sources, we added a Google Scholar search and inspected the references of studies that qualified for full text review (backward searching).

Study selection and inclusion criteria

Two independent reviewers (VG and VF) screened all titles and abstracts and then reviewed potentially relevant articles based on full text. They resolved differences through discussion before coming to consensus. If no consensus was reached, a third independent reviewer solved discrepancies between the two reviewers.

We included prospective and retrospective observational studies (case-control, or cohort) cross-sectional studies, and interventional studies (randomized and non-randomized) that studied an adult

palliative population (≥18 years old), at the end of life, with severe illness or with a disease end-stage and compared hospital visits or health care costs of those who received palliative care at home to those who received usual care. Usual care might include palliative care in the hospital, but not at home. We defined HBPC as palliative care that includes home visits.

Data extraction

We used a predesigned data collection form to extract relevant information from the selected studies including study design, sample size, characteristics of the study population, intervention and type of controls. We also extracted the outcomes each study assessed, and the correspondent measure of associations (e.g., hospitalization rate, mean length of stay, overall cost, inpatient cost, prevalence of death at home).

Assessing the risk of bias

Three reviewers (VG, VF and NG) independently rated study quality based on the Joanna Briggs Institute Critical Appraisal Tools Checklists for use in systematic reviews. The checklist has 11 items for cohort studies, nine items for quasi-experimental studies, and 13 items for RCTs.

Data synthesis

We conducted a narrative synthesis of the findings of the included studies. For each study, we determined if cost or utilization differed between groups, and whether the difference favored the intervention or the control. Initially, we sought to pool their results using a random effects meta-analysis model. Because studies varied in duration and type of exposure, the time points of outcome assessment, and were conducted in different health systems, we could not pool these results. However, we could make a summary estimate of cost savings by calculating the percentage of costs reduced by the HBPC intervention for those studies that reported the difference between overall costs for patients with and without HBPC. Because several studies reported total costs at different time periods (e.g., from 6, 3, or 1 month until death) we performed two calculations: one included data from the period furthest from death and the other included data from the period closest to death. For

studies that stratified cost by groups (e.g., disease), we calculated the average cost in savings across the groups.

Results

We identified 1,426 unique references (**Figure 1**). Based on the title and abstract, we selected the full text of 30 articles for detailed evaluation; 21 of these articles, based on 19 studies, met our eligibility criteria and were included in this review. **Figure 1** explains the reasons why the remaining nine articles were excluded.

General characteristics of the included studies

Table 1 details the characteristics of the 19 included studies, which together included data on 92,871 people. Most of the studies (n=12) assessed health care cost and use, six assessed only health care use, and one assessed only health care cost. Ten studies assessed the place of death. The majority of the studies (n=9) included participants from the U.S., two from Italy, and the rest included participants from Belgium, Denmark, England, Israel, Singapore, Spain, Sweden, and Taiwan. Twelve were retrospective cohort studies, five were quasi-experimental studies (before-after studies), and two were randomized controlled trials (RCT).

Most of the studies included both oncological and non-oncological patients (n=10) (Brian Cassel et al., 2016; Chitnis, Georghiou, Steventon, & Bardsley, 2013; Hopp et al., 2015; Kerr et al., 2014; Lukas, Foltz, & Paxton, 2013; Lustbader et al., 2017; Maetens et al., 2019; Murphy, Siebert, Owens, & Doorenbos, 2013; Pouliot, Weisse, Pratt, & DiSorbo, 2017; Sudat et al., 2018); six studies (reported in seven publications) included only oncological patients (Alonso-Babarro, Astray-Mochales, & ... 2013; Bentur, Resnizky, Balicer, & Eilat-Tsanani, 2014; Blackhall et al., 2016; Chiang & Kao, 2016; de Miguel, Rubert de la Piedra, Garcia Perez, Garcia Ruiz, & Alonso Babarro, 2018; Riolfi et al., 2014; Skov Benthien et al., 2018), two studies (reported in three publications) included only patients with heart failure (Brannstrom & Boman, 2014; Sahlen, Boman, & Brannstrom, 2016; Wong et al., 2013), and one study

included non-oncological patients (Ferroni et al., 2016). Non-oncological conditions included in the studies were dementia, senility, respiratory disease, liver disease, kidney disease, coronary artery disease, neurodegenerative disease and diabetes.

Supplementary Tables 1-3 show the risk of bias assessment for each study. Although randomized controlled trials are rare within palliative care research, we found three. These studies were the studies at lower risk of bias. The risk within those studies mainly consisted out of non-concealment of the HBPC intervention. The five quasi-experimental studies also had low risks of bias scores. The biggest problem with quasi-experimental studies was the lack of an independent control group as those studies were before-after studies. The 13 retrospective cohort studies were at higher risk of bias due to unclear or non-existing handling of confounding (Chiang & Kao, 2016; de Miguel et al., 2018; Lustbader et al., 2017).

Home-based palliative care intervention

Out of the 19 studies, 18 clearly described the intervention. The remaining one, used claim data to search for care codes and those patients with home hospice codes were included in the intervention group (Chiang & Kao, 2016). The majority of the studies (n=11) consisted of a multidisciplinary team that involved nurses, PC specialists, social workers, psychologists, physiotherapists, chaplains or other spiritual care providers. In five studies, the care in the intervention group was only provided by physicians and nurses, in one by palliative care specialist and heart failure specialist and in one by nurses and assistants (**Table 1**). At least six of the studies stated the availability of the assistance was 24 hours per day, 7 days of the week, whether face-to-face or by telemedicine.

Main outcomes

Hospital use

Hospital admission

Fourteen studies assessed hospital admission rates; two of these evaluated admissions to an intensive care unit (ICU) (Brian Cassel et al., 2016; Maetens et al., 2019). Most studies (n=9) compared groups of patients who had and did not have access to HBPC (**Table 1**). These studies found that the group of

patients with HBPC had smaller percentage of patients being hospitalized or admitted at least once to the ICU compared to the group without HBPC. Additionally, the group with HBPC showed a lower average number of hospitalizations per patient or per intervention group and lower risk of hospital admission. Only one study, a secondary analysis of an RCT, noted more hospital admissions in the intervention group, but the difference was not significant. This study's results were derived from an intention-to-treat analysis in which two thirds of the patients in the control group also received the intervention (Skov Benthien et al., 2018).

These results aligned with the results of the five quasi-experimental studies in which the control was the patient before HBPC intervention. These five studies found hospital admissions dropped after the HBPC service was introduced regardless when the mark before/after was chose. Four of them compared the hospital admissions in a symmetric way, for example, 18 months before intervention vs 18 month after intervention (Lukas et al., 2013), or six months before vs six months after the intervention (Hopp et al., 2015). They found the reduction in hospital admission to be significant (Hopp et al., 2015; Lukas et al., 2013; Pouliot et al., 2017; Wong et al., 2013). The remaining study, which was the only one not assessing the outcome in a symmetric way, did not reach the stablished significance level (Murphy et al., 2013).

Hospitalization length

The length of hospital stay was assessed by nine studies. All of them found that significantly shorter hospital stays were significantly shorter among patients with HBPC than among controls. One study of more than 7,900 oncological and non-oncological patients compared the length of hospital stay over the last three months of life in patients receiving HBPC compared to their matched controls. They found a significant reduction in length of hospital stay in the patient group receiving HBPC. They found that the number of days in hospital during the last three, two, and one months of life was significantly reduced; the difference was greater than 30% (Sudat et al., 2018). Another study of more than 2,000 non-oncological participants assessed the risk of prolonged hospitalization at the end of life, defined as a stay that exceeds the 75th percentile of the stay that occurred during the last month of life. The

authors found that there was a dose–response relationship: risk decreased with an increase in the number of HBPC visits per week (Ferroni et al., 2016) (**Table 2**).

Emergency Department admission

Seven studies assessed emergency department admission; five found that patients with HBPC used significantly less ED, measured as the percentage of patients admitted at least once to ED or as risk of an ED admission. One large study of over 59,000 oncological patients found that only 12% of the patients with HBPC had at least one ED admission vs. 35% of the matched controls (Chitnis et al., 2013). Another large study of more than 17,000 oncological and non-oncological patients found that the risk of ED admission during the last two weeks of life was twice as high for those without HBPC than those with HBPC (Maetens et al., 2019). The remaining two studies found no difference or an insignificantly lower difference in ED use (Bentur et al., 2014; Murphy et al., 2013) (**Table 2**).

Health care cost

Average overall cost

There were 11 studies assessing this outcome. Of them, the majority of the studies (n=10) compared a group of patients who had access to HBPC to patients without access. The remaining study used the same patients as controls (before introduction of HBPC) and as the intervention group (Hopp et al., 2015) (**Table 1**). The studies assessed the outcome over different periods, ranging from the last month to the last year of life (**Table 3**). Seven studies included both oncological and non-oncological patients (Brian Cassel et al., 2016; Chitnis et al., 2013; Hopp et al., 2015; Kerr et al., 2014; Lustbader et al., 2017; Maetens et al., 2019; Sudat et al., 2018), three only oncological patients (Bentur et al., 2014; Blackhall et al., 2016; Chiang & Kao, 2016), and one only patients with heart failure (Sahlen et al., 2016).

Of the 11 studies that assessed overall cost in health, six studies specified that they had taken into account the costs of the intervention itself while the other five did not specify whether they had included these costs or not. When taking into account all the articles that evaluated overall cost in health, regardless of whether or not they included the costs of the intervention itself, average total health care cost per patient was lower for those with access to HBPC than for controls.

Studies that assessed the outcome at different points in time found that the cost reduction was most noticeable closer to death, with the greatest reductions in the last two months, one month, and two weeks of life (Blackhall et al., 2016; Kerr et al., 2014; Lustbader et al., 2017). Including all 11 studies assessing average overall cost, the intervention saved 36.3% (IQR: 28.8%-51.8%) when taking into account the costs reported at the period closest to death. Similar results were obtained when taking into account for the analysis the cost reported at the period most distant to death, with a saving in the overall health cost of 35.7% (IQR: 26.2%-36.8%) in favor of the HBPC group.

The largest study, a retrospective cohort that included more than 29,500 oncological and non-oncological patients who had been under HBPC and had died matched them 1:1 to patients without HBPC who died during the same period, had similar demographic and clinical characteristics, and similar prior hospital use; average overall cost per person for those under HBPC was significantly lower than the cost for the controls (Chitnis et al., 2013).

Those six studies that took into account the cost of the intervention program(Brian Cassel et al., 2016; Kerr et al., 2014; Lustbader et al., 2017; Maetens et al., 2019; Sahlen et al., 2016; Sudat et al., 2018), also found a reduction in average total health care. Of them, three large studies summing up more than 27,000, found costs to be lower among patients with HBPC in the last three, two, and one months of life (Brian Cassel et al., 2016; Maetens et al., 2019; Sudat et al., 2018). One of these studies presented results by patient diagnosis and found that cost reductions were significant across all conditions they included (cancer, COPD, heart failure and dementia) (Brian Cassel et al., 2016). Another study taking into account the cost of the intervention program analyzed the average overall cost in different periods (Kerr et al., 2014). This study showed that patients with HBPC had significantly lower average overall costs compared to patients without HBPC during the last three months, last month, and last two weeks of life. When they analyzed these same costs during the last six months and last two years of life, the costs were equal between both groups. Another study, found HBPC lowered cost over the last year of life and significantly lowered cost over the last six months, last three

months, and last month of life (Lustbader et al., 2017). Outpatient cost and staff cost were generally equal or higher for patients with HBPC than for patients without HBPC (Kerr et al., 2014; Maetens et al., 2019; Sahlen et al., 2016), so the drop in overall health care costs was a result of significantly lower inpatient cost among patients with HBPC.

Hospitalization cost

Seven studies assessed costs generated by hospitalizations, and all found that inpatient costs were lower in patients who received palliative home care. One RCT conducted among patients with heart failure with six months follow-up found that inpatient cost in the group with access to HBPC was at least three times less than the cost in the control arm (Sahlen et al., 2016). Two large retrospective cohorts with a combined total of over 25,000 participants, used matched analysis to adjust for confounders and found significantly lower hospitalization cost among patients with HBPC during the last three months, two months, one month, and 2 weeks of patients' life (Maetens et al., 2019; Sudat et al., 2018) (**Table 2**).

Other costs

Two studies assessed outpatient cost. Of them, one included the home care cost in the outpatient cost and found higher values for those with access to HBPC (Maetens et al., 2019). The other one reported no difference in cost at six months before death and lower cost in the lasts three months, two months and two weeks of life among patient with access to HBPC. This last study, additionally reported costs derived from visits to the emergency department and found no difference in none of the time periods (Kerr et al., 2014) (**Table 2**).

Additional outcomes

Place of death

Among the ten studies reporting this outcome, six reported percentage of deaths at home. Among this studies, the percentage of patients who died at home was at least twice as high among those who had access to HBPC compared to those who did not, with a ratio ranging from 2.2 to 6.8 (Bentur et al., 2014; Chiang & Kao, 2016; Chitnis et al., 2013; de Miguel et al., 2018; Maetens et al., 2019;

Riolfi et al., 2014). Three studies reported the percentage of patients who died outside the hospital, including home and health care facilities such as hospices (Blackhall et al., 2016; Brian Cassel et al., 2016; Sudat et al., 2018). Their results were consistent, with higher amount of patients dying outside hospitals in the HBPC group. Finally, the remaining study reported the risk of hospital in each group and found that relative risk of hospital death decreased with a dose–response relationship, according to the number of homecare visits per week performed in the last months of life (Ferroni et al., 2016).

Discussion

Main findings

We found HBPC was consistently effective on reducing the number and length of hospital visits, regardless of a patient's oncological status. The number of emergency department visits was lower or equal to the number in the control group. HBPC consistently reduced health care costs by reducing costly hospital stays, even though home-treated patients consumed more outpatient resources.

Since the studies designed their interventions differently and were implemented in widely different health systems, they were too heterogeneous to allow us to conduct a meta-analysis so we could not generate a pooled estimate cost saving. Despite their heterogeneity, their results consistently demonstrate that HBPC reduced costs.

This review found cost reductions were highest in studies that assessed the outcome closer to death possibly because the number of hospitalizations increase as patients near death, and with it the number of hospital deaths (Alonso-Babarro et al., 2013; Bentur et al., 2014; Blackhall et al., 2016; Chiang & Kao, 2016; Chitnis et al., 2013; de Miguel et al., 2018; Maetens et al., 2019; Riolfi et al., 2014). The average number of hospitalizations increase when the patients nears death, because chronic diseases progress, symptoms worsen and standard (home) care is overburdened. Additionally, when a patient is hospitalized in a period close to death, the chances of dying in the hospital increase which

can be showed to be much more expensive than dying in another setting. Using data from Medicaid, data analysts reported that dying in hospital is seven times more expensive than dying at home (Solutions, 2016).

Applicability of evidence

All the studies we included were carried out in high income countries where the cost of hospitalization is higher than it is in middle- and low-income countries ("World Health Organization. Public Spending on Health: A Closer Look at Global Trend," 2018), so our results may not be generalizable to those countries. To improve the applicability of our evidence, we provided the results of the savings in the average overall health costs as percentages, instead of net decrease in costs. However, the results from our systematic review should be taken with caution before generalization.

Limitations

The studies we included did not aggregate the total cost of health care. They did not include out-of-pocket expenses or other informal costs of care like the drop in household income when family members reduce their working hours to help care for a patient at home. These costs are difficult to measure but informal care has shown to account for a high proportion of costs during the last year of life, highlighting the important role of informal caregivers in PC (Brick et al., 2017). There is a risk that HPBC reduced overall health care costs less than they appeared to, since they may have shifted costs from the system to patients and their caregivers, and thus rendered those costs invisible.

As others also report (Brereton et al., 2017) we were limited by the fact that study authors did not clearly describe their interventions, which meant we could draw only general conclusions. For example, most authors did not clearly define the precise content of HBPC or describe patient diagnosis and any associated need for intensive and specialist care in hospitals, although these influence the hospital admission rate. We could only focus on cost and easily measurable effect outcomes like hospital utilization, but did not have enough comparable information to include important effectiveness outcomes like quality of death and the burden imposed on family caregivers.

Studies were generally of good quality but because few clearly reported the exposure there is a risk of non-differential misclassification, which could have led us to underestimate the effect. Additionally, given that most studies were observational, despite having used different strategies to control for confounders, there may still be residual confounding introducing bias into the results.

Despite the heterogeneity of interventions and study design (**Table 1**), results were consistent across studies, especially for health care cost outcome, but there was some inconsistency in findings about use of health care. Skov et al.'s study, a secondary analysis of an RCT that assessed hospital admissions as outcome, found no difference between those randomized to specialized PC at home and those in the control arm (usual care including referral to specialized PC at home on demand); 66% of patients assigned to the control group received specialized PC at home (Skov Benthien et al., 2018). Bentur et al.'s study was also problematic, since patients in the reference group also received home-base care as part of usual community care (Bentur et al., 2014).

Implications

The ethical argument for HBPC is strong for patients with a marked prognosis decline who want to remain at home. Our study bolsters that ethical argument with evidence that HBPC reduces health care system costs.

When analyzing the cost-effectiveness of a new intervention, results are divided in into four quadrants. If a new intervention is less effective and more expensive (upper left quadrant), it ought to be discarded. If it is more effective but also more expensive (upper right quadrant) or less effective and cheaper (lower left quadrant) it warrants discussion. If it is cheaper and more effective (lower right quadrant), it is dominant and should be implemented. Therefore, from an economic perspective, our finding that HBPC decreases hospital visits while decreases costs suggests that, when properly analyzed in a cost effectiveness analysis, the home-based approach may be a dominant technology when compared to the traditional care (Petrou & Gray, 2011). However, the

studies identified did not report classic cost-effectiveness metrics such as the incremental cost-effectiveness ratio (ICER). Therefore, we could not perform cost-effectiveness analysis.

HBPC should be available to all patients in a recognizable end-of-life phase, e.g., with marked progressive decline, who desire to remain at home and die there. Further research would be necessary to determine which specific type of patient benefits the most from HBPC and has the highest impact on reducing health care cost. Our findings apply at the population level, but patients must be managed individually, taking into account the complexity of their underlying pathology to determine if patients with complex conditions (e.g., polymorbid patients) will benefit most from HBPC or in-hospital management. We thus recommend linking HBPC programs to a hospital PC program in case referral is necessary. In addition, reducing hospital utilization at the end of life should be a goal for health care planners only if access to quality home care at the end of life is guaranteed. The main objective should not be where to die, but how.

Conclusion

Our systematic review provides clear and homogenous evidence that home-based palliative care reduces overall end-of-life health care costs by reducing the number of hospitalizations in the last months of life, and thus the number of in-hospital deaths. Therefore, stakeholders should recognize HBPC as an intervention that decreases patient care costs at end of life and health care providers should assess the preferences of patients nearing the end-of-life to identify those who will benefit most from HBPC.

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